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DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HUGH M. SMITH, Commissioner

THE MENHADEN INDUSTRY OF THE ATLANTIC COAST

By ROB LEON GREER

APPENDIX III TO THE REPORT OF THE U. S. COMMISSIONER OF FISHERIES FOR 1914

Bureau of Fisheries Document No. 811

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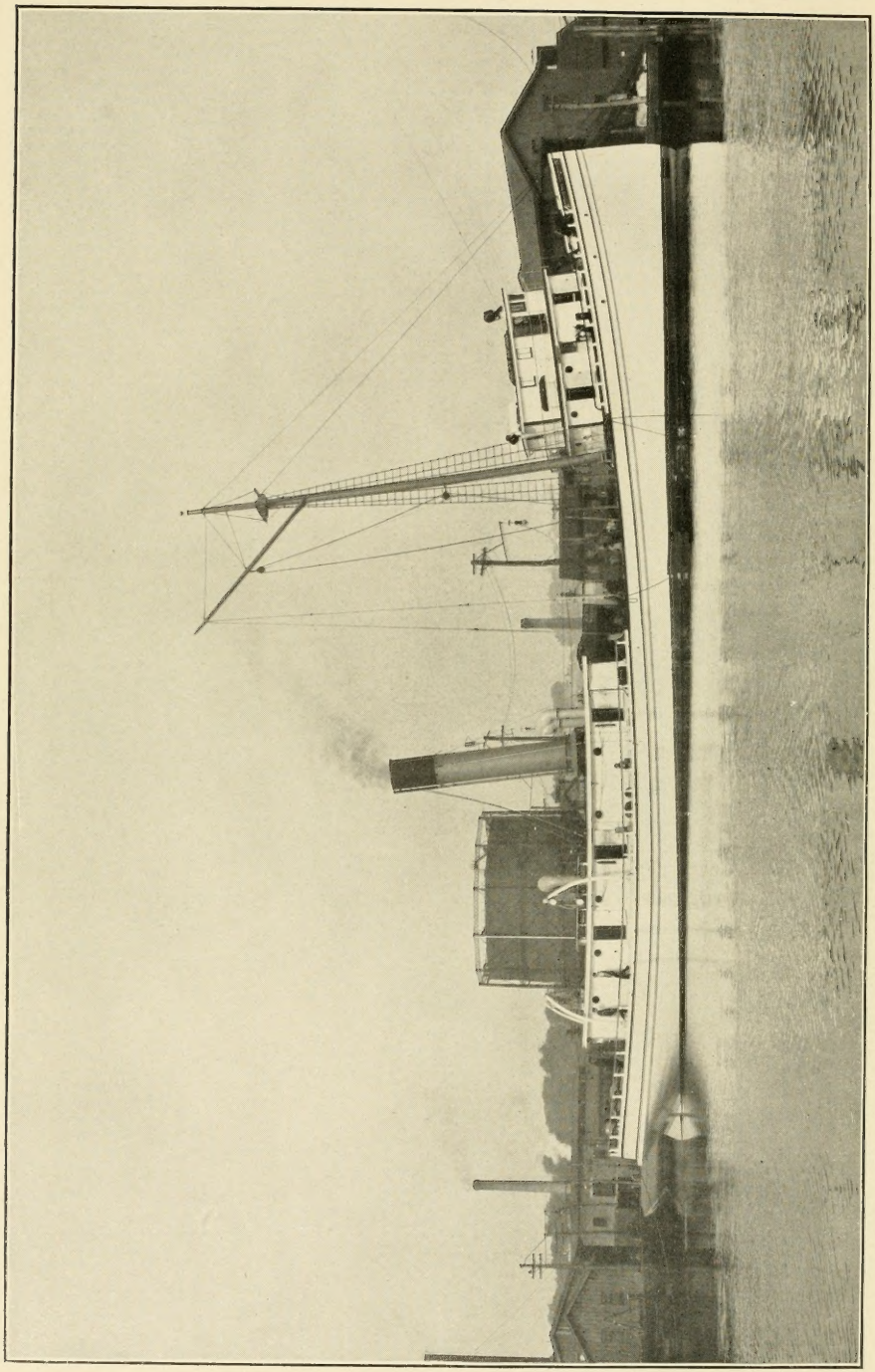

STEAMER USED IN MENHADEN FISHERY.

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By Rob Leon Greer

Appendix III to the Report of the U. S. Commissioner
of Fisheries for 1914

CONTENTS.

	Page.
History and extent of the menhaden fishery	5
Factories	6
Vessels	7
Purse and striker boats	8
Fishing apparatus	8
Season and fishing grounds	10
Fishing methods	11
Capture of edible fish	13
Unloading and weighing or measuring	14
Cooking	15
Pressing	16
Screw press	18
Drying	19
Oil	21
Fishermen	26
Factory employees	26
Laws governing menhaden fishing	27

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By Rob Leon Greer.

HISTORY AND EXTENT OF THE MENHADEN FISHERY.

The taking of menhaden for fertilizing purposes dates back to the early settlers who first placed them on their ground as whole fish; later, when the value of the oil was discovered, it was extracted by placing the fish in casks, covering them with water, and compressing with weighted boards. In this process, the fish soon became putrefied, the oil cells disintegrated, and the oil floated to the surface and was skimmed off from time to time. The first process of cooking was by the use of kettles in which the fish were boiled; the mass was then placed in casks and treated as above, with the result that much more oil was secured than before. The residue was then used as fertilizer.

The next advancement in the industry, which had been of little importance up to this time, was when steam cooking superseded the use of the kettles. The first steam factory was established in Rhode Island; others were subsequently erected on Shelter Island, N. Y., and in Connecticut and Maine. In December, 1866, the steamer *Ranger*, hailing from Greenport, N. Y., was sent to Virginia. She was equipped with the necessary apparatus for cooking the fish and extracting the oil on board, and so far as is known was the first floating factory. The fish were caught in purse seines operated from sailing vessels. She remained there only about 11 days during that year, but returned each of the two succeeding years. The first factories built in Virginia were established by northern companies in 1868; one was on Tanners Creek and another on Back River, though it was not until the following year that the work was taken up at Reedville, in Northumberland County, which place is now the most important fish-scrap center on the coast. The first menhaden factory in North Carolina was built on Harkers Island, in Core Sound, in 1865.

During the year 1912 there were 48 menhaden factories on the Atlantic coast, having a total valuation of $3,625,983, distributed by States as follows: Maine, 1; Connecticut, 2; New York, 5, including one floating factory; New Jersey, 5; Delaware, 2; Maryland, 1; Virginia, 19; North Carolina, 12; and Florida, 1. The vessels engaged in fishing for menhaden for these factories numbered 147, valued at

$3,456,792; the total net tonnage was 13,566. Of these 118 were steamers, valued at $3,303,292, and 29 were gasoline boats, valued at $153,500. Two hundred and seventy-four purse seines, valued at $271,000, and 386 seine and striker boats, valued at $83,135, were used. The number of persons employed in and about the factories was 2,159, their salaries and wages for the year amounting to $560,834; the number of fishermen engaged was 3,735, and their wages amounted to $1,018,150. The total number of menhaden utilized was 1,061,843,750, which yielded 6,651,203 gallons of oil, valued at $1,551,990, and 88,520 tons of scrap, valued at $2,138,165.

The degree of success attending this important fishery, which is prosecuted annually, varies greatly; the number caught and also the fatness of the fish is much greater some years than others; consequently, similar catches do not always yield similar quantities of oil. The catch of 1911 was probably one of the largest ever known and the large dividends paid that year gave the industry such an impetus that four new factories were established during that season and eight in 1912; in addition to these, four new ones were being operated in 1913 and two others were under construction. It may be incidentally stated that the fishing during the season of 1913 was practically a failure, at least two of the factories having been forced into receivers' hands. Despite this increase in the number of factories during the last three years, there are not now as many as have been operated during some previous years. But when it is considered that the present-day plants are so much larger and the modern equipment so greatly facilitates the handling of the fish, the possibilities are probably greater to-day than ever before.

FACTORIES.

A menhaden factory should be within a few hours' run of the fishing grounds and also on deep water, to avoid the necessity of building a long wharf to reach from the plant to a channel of sufficient depth to float the steamers, many of which have considerable draft. This, however, is not always possible; one factory has a wharf 1,100 feet long, and at another place the entire plant is built over the water. The elevator or other device for removing the fish from the hold of the steamer and the device for measuring the fish are always placed on the outer end of the wharf; the "raw box" may be either on the wharf immediately back of the elevator or on the other end near the factory.

The chief desire in drawing plans for the building is to have the machinery so arranged as to facilitate the handling of the fish, and for this reason the most of the buildings have two stories. The cooker is generally on the ground floor quite close to the raw box; in some plants it is not in the building but is placed on the outside with only

a roof to protect it from the weather. The presses are generally placed on the second floor and the oil tanks are at a lower level, so that the oil and water flowing from the presses reach them without the use of a pump; these tanks are frequently found on the outside of the building with no covering, though in most of the northern plants they are under roof. The drier is on the ground floor, either in the building or under a shed. The equipment of the average factory, therefore, consists of an elevator, measuring device, raw box, cooker, press, drier, and oil tanks, with the necessary bucket, chain, or screw conveyors for moving the material from one part of the plant to another.

The power of the boilers and engines naturally depends upon the equipment of the factory; two 125-horsepower boilers, costing about $1,500 each, are sufficient for a plant having one cooker, two presses, and one drier; the cost of the entire equipment of such a plant is approximately $24,000 and the capacity is about 600,000 fish in a day of 12 hours. The largest factory on the coast has a daily capacity of about two and a half millions of fish and employs upward of 200 men.

In addition to the main factory there are several other buildings set apart; these include the office, the "scrap room," in which the scrap is bagged and stored until such time as it is to be shipped, the mess house, and the sleeping quarters for the men. Some of the factories built during recent years have cement floors, this material having found favor among the operators because it is more durable and also more easily kept clean than wood; and many of them are lighted by electricity generated on the premises, one having installed, in addition to a plant for lighting, electric motors for operating the machinery.

VESSELS.

In the early days of menhaden fishing the vessels were all schooners and sloops; steamers were introduced some time during the seventies, but the sailboats were also employed for a number of years after the advent of the steamers. The present-day steamers are built somewhat on the tug model, with an extra high bow, which serves a twofold purpose, that of rendering them more seaworthy and giving the pilot the advantage of a much greater scope of the sea. The quarters are forward and the engine, boilers, and bunkers toward the stern, leaving the hold in the middle of the boat where the deck is low so as to facilitate the transfer of the fish from the net. The auxiliary schooners, which are all owned in North Carolina, with the exception of two in New Jersey and one in Maryland, have practically the same arrangement. While the total number of vessels now employed in this industry is not as great as some previous reports have shown, the

fact that they are now all propelled by steam or gasoline gives them a great advantage over the sailing craft formerly used. They can go farther in search of the fish and can return to the factory very much more quickly when a load is secured and are not so often delayed by inclement weather. Many of the steamers now in use are lighted by electricity and also have searchlights and are modern in every detail. The largest one in use during 1912 has a capacity of over a million fish, but a larger one was built in 1913 at a cost of $100,000 and with a capacity of at least one and one-half million fish. The largest gasoline boat fishing for menhaden has a capacity of 400,000 fish and is owned in New Jersey. Twenty-seven new steamers were built in 1911 and 1912 and several new ones were in course of construction in 1913. It is seen from the above figures that the Chesapeake region leads in both the number of factories and the number of steamers in use.

PURSE AND STRIKER BOATS.

The purse or seine boats must necessarily be built very strong to withstand the great strain to which they are subjected; they frequently put out in rough seas, and there is also considerable strain when handling the seine. Cedar is mostly used in their construction, for both the planking and the ceiling. In the stern a platform measuring about 3 feet fore and aft is built 10 inches below the gunwale; upon this the captain stands to direct the movements of the boat; a similar platform is in the bow and upon this stands the man who handles the cork line when pursing the net. There is also a platform or floor in the bottom of the boat. There are four thwarts, three of which are forward and the fourth immediately forward of the after platform referred to above; the intervening space is for stowing the seine. The stern of these boats is built about 2 inches higher than the bow so that they may be properly balanced when the seine, most of the weight of which is toward the stern, is aboard. The dimensions are as follows: Length, 28 to 33 feet, though the preferable length is 32 feet; beam, 6 to 7 feet; depth, 2 feet to 2 feet 10 inches amidships. The cost ranges from $275 to $400.

The striker boats are simply small rowboats, carvel built, with a sharp bow and square stern. They are about 12 feet long, 4½ feet beam, and 1 foot 9 inches deep amidships. The striker usually stands when rowing, on a small platform in the bottom of the boat. The cost of these boats is $100 to $120.

FISHING APPARATUS.

By far the greater portion of menhaden handled at the factories is caught in purse seines, about 98.7 per cent of the entire catch of the year 1912 being taken with that form of apparatus; the greater part

of the rest was taken in pound nets fished in Raritan Bay, N. J., and converted into scrap at a factory located at Port Monmouth, in the same State. Some were also caught in pound nets in New York and Virginia. Only one factory, one of the smaller ones in North Carolina and probably the smallest on the entire coast, depends entirely on the shore fisheries for its supply of fish; their apparatus consists of gill nets 175 to 200 yards long, 5 feet deep, with 1½-inch mesh. They are fished from small sailboats having a capacity of about 7,000 fish each and carrying one man each.

The purse seines in general use are about 135 to 200 fathoms long, 9 to 10 fathoms deep, with 1¾-inch mesh; the size of the twine used for knitting them varies in the different parts according to the tension to be applied, the heaviest being in that part called the "bunt" for the reason that it bears practically all the weight of the fish when the seine is pursed; this consists of a square of 400 to 500 meshes in the center of the net and it is made of no. 15 and no. 18 cotton twine. The other parts of the net are made of no. 20–9 and no. 20–12 twine. The cork and ring lines at the top and bottom, respectively, are both no. 12 thread, right; there are two additional lines, no. 9 thread, left, to which the seine is hung. These run parallel to the cork and ring lines the entire length of the net and are lashed to these lines at regular intervals.

The four lines indicated above are all manila rope. The purse line is no. 36 thread, Russian hemp, about 150 fathoms long. The brass rings through which the purse line passes are 4 inches diameter, weigh 1½ pounds, and cost 50 cents each; these are suspended from the lower line on beckets or loops each 6 to 12 inches long and 3½ to 5 fathoms apart. The final rings are placed about 10 fathoms from the ends of the net. In order that the center of the net may be located, the "ring" placed at that point is shaped more like a stirrup, so that it may easily be distinguished from the others. The corks vary in size from 3 to 4½ inches in diameter, the larger ones being placed at and near the center of the seine in bunches of three or four quite close together, so arranged because the greatest weight is on that part when the net is pursed; the smaller corks are toward the ends of the net and placed farther apart than the others. From 2,200 to 3,200 corks, costing from $30 to $45 per thousand, are used on a purse seine. The beckets, to which the "hank" lines on the gunwale of the steamer are made fast for the purpose of holding the net close to the vessel when the fish are being transferred, are arranged along the top of the net at the center of the bunt at intervals of about 2 feet; there are 20 to 24 beckets, each about 1 foot long. To prevent rotting, the top and bottom lines are tarred, but the purse line is not so treated, because it would become too stiff and consequently difficult to handle; for the same reason the net is tarred but once, and that when new.

The subsequent treatment for its preservation consists of a pickling process as follows: After the day's fishing is done, about 4 bushels of coarse salt are sprinkled over each "arm" of the seine as it lies in the seine boats; 12 to 15 buckets of sea water are then poured over each arm, and as that collects in the bottom of the boats it is pumped into buckets and poured over the twine—the same water, or brine, as it has now become, being used over and over until 75 to 100 bucketfuls have been poured; this is repeated in the morning and perhaps several times during the day, if the net has not been put overboard and so much sea water taken aboard with it that the "pickle" is too much diluted to be of further service.

When the twine is very slimy, as is frequently the case after a haul has been made, it is washed by a stream of water from the fire hose on the steamer. The cost of a seine completely rigged for fishing is about $1,000; and they are seldom used more than one season. The "long tom" is simply a large piece of lead with flat bottom and rounded top, weighing about 300 pounds, which is placed upon the purse line by the use of two snatch blocks which are fixed in its sides and dropped overboard after the net has all been paid out, to hold the ends of the net before it has been pursed. An eyebolt is fixed in the top of the tom for the attachment of a line used for the purpose of hauling the weight back into the boat. The cost of a tom is about $30.

SEASON AND FISHING GROUNDS.

As the menhaden is a migratory fish, the season naturally differs on various parts of the coast; the location of the factories governs to some extent the range covered by the fishing steamers, it being desirable to remain close enough to their respective factories to run in and discharge their fish before they putrefy; but the steamers sometimes get so far away that they find it advantageous to sell their catch to some other factory. As the fish appear to seek the coast the steamers seldom go more than 10 or 15 miles out to sea. While menhaden occur in Florida throughout the year, the bulk of the catch is taken from April 1 to November 1. The small catch in winter, according to the fishermen, is owing to the fact that the fish seldom appear at the surface of the water during that season. The steamers fishing in Florida seldom go farther than 10 or 15 miles north or south from the mouth of the St. Johns River. Some fishing is also done in that river and Nassau Sound, but the catch in those waters is inconsiderable. The spring and fall "runs" determine the season for the North Carolina fishermen; the northward movement generally ends about June 15 to 20 and very little fishing is done from that time until the schools reappear southbound during late September or early October. The bulk of the catch taken by the boats from this State is from outside waters, generally from Cape

Fear to Ocracoke Inlet; some are also caught in Core Sound. The steamers hailing from Chesapeake Bay region generally begin operations the first or second week in May; the work is chiefly at sea from the beginning of the season until the first of July, and during that month and throughout August and September practically all the fishing is done in the bay, from which it is estimated that fully 75 per cent of the entire catch is taken. From September until the close of the season, which is usually November 10 to 15, the vessels go outside again. The range covered by the Virginia vessels is from Cape Hatteras on the south to Sandy Hook on the north. The season and fishing grounds for the Delaware and New Jersey steamers is practically the same as that given for those from Virginia, except that they are excluded from Chesapeake Bay. The New York and Connecticut menhaden fishermen have a shorter season and their range differs in that they seldom go farther south than the Virginia capes; their northern limit is rarely extended beyond Boston Bay, though the northern limit of migration of the menhaden is the Bay of Fundy, but they are not found in sufficient number to warrant going farther than is here stated. Schools of menhaden were reported in Casco Bay a few years ago but very few were caught. Some are also caught in Long Island Sound, Vineyard Sound, and Gardiners Bay.

FISHING METHODS.

The time of the steamer's departure from the factory depends chiefly upon the running distance to the fishing grounds; they are usually in readiness and off by 4 o'clock in the morning, though they frequently go earlier. It is the general belief among the fishermen that the early morning is the best time for fishing. Very little attention need be given to the tides when fishing offshore, but in inside waters the tide is often so strong as to render the handling of the seine difficult, and better results are obtained when working on slack water. As soon as the fishing grounds are reached the captain and the mate repair to the "crow's nest" at the mast, from which point of vantage they survey the surrounding waters to locate the fish, an experienced eye readily distinguishing the reddish hue which indicates their presence. When a school is sighted, those aloft rapidly descend and prepare to "lower away" the seine boats; the striker drops off in advance and rows toward the fish to keep trace of them and indicate to the captain, by signals made with an oar, the direction in which they are moving. The captain is in charge of one of the boats and the mate directs the movements of the other.

At the opportune time the seine, one-half of which is stowed in each boat, is thrown out by the "seine setters," the oarsmen rapidly rowing in a circular direction in order that they may surround the fish; the striker in the meantime has taken a position on the opposite side

of the school and by splashing the water with an oar endeavors to prevent their escape. When the two boats meet a large hook attached to a line made fast to the bow of the mate's boat is caught under the center thwart of the captain's boat to prevent them drifting apart. The tom is then dropped overboard and the men begin hauling both ends of the purse line through two snatch blocks which are attached to an upright iron support about 18 inches high called the "crane" and which is fitted in the port gunwale of the captain's boat about 10 feet from the bow; the line is carried directly across to two snatch blocks hung to the starboard gunwale, the one end continuing on toward the stern and through another block attached to the same gunwale and the other end going to the men in the mate's boat. The ends of the net are hauled into the boats as it is being pursed and arranged in an orderly manner so as to be in readiness for the next set; when the rings are all in, the tom line is placed in one of the blocks on the crane and the tom hauled aboard. The hook referred to above as holding the boats together is then released and the bows are lashed together.

It is sometimes necessary for the striker to tend the cork line to guard against its being submerged when the fish are all in the bunt of the net. When all is in readiness the captain signals to the pilot to bring the steamer alongside for the purpose of transferring the fish to the vessel hold. The hanks, which hang along the gunwale, are made fast to the beckets on the bunt of the seine so as to hold it close to the vessel, and the bailing begins. The bailing net is simply a bag 4 feet deep, made of cotton twine and hung to a circular frame about 4 feet in diameter, made of 1-inch iron; it has a wooden handle approximately 12 feet long. The net is suspended from a boom hung to the mast directly over the hold and so arranged as to swing back and forth; it is raised by a small engine placed on the deck a little aft of amidships. The fish are dumped by means of a line attached to the bottom of the net and passing through a block hung to the boom above. Two other lines attached to the rim of the net, one held by a man standing on the deck of the steamer and the other by a man in one of the seine boats, are designed to assist in guiding the net as it is raised and lowered. The handle is controlled by a man standing on the deck along the gunwale.

It is possible to handle fish at the rate of a half million an hour with this net. When a set is made and the seine found to be empty when pursed it is said to be a "stab"; when they begin paying out the net and the fish are seen to disappear before it is all out, it is a "pull-back." The usual time required for making a set and pursing the seine is 30 to 40 minutes.

No fishing is done at night; the steamers always make some harbor, preferably their home port, but if too far from that they run in to some place more convenient.

CAPTURE OF EDIBLE FISH.

Much has been said during past years regarding the use of edible fish taken in the menhaden nets for the manufacture of fish scrap. That the number of such fish actually taken in purse seines with the menhaden is, however, too inconsiderable for discussion seems to be conclusively shown. While the menhaden are being taken aboard the steamer the cook usually stands over the hold with a long pole, in the end of which is a hook, for the purpose of removing the edible fish which are wanted for the ship's mess; his keen eye misses few mackerel, trout, etc., but even with this vigilance he does not secure enough to provide food for the crew. The writer spent a day on one of the largest steamers owned in Virginia, and in a total catch of 240,000 menhaden for the day there were only 8 mackerel and 10 bluefish. At times, however, the vessels may strike a school of some edible species and carry them to market; it is probably safe to say that such fish are never converted into scrap. The Virginia captains have explicit instructions to avoid taking food fish, and an instance is on record of one of the most proficient captains in the business being dismissed for disobeying the order.

Considerable quantities of alewives, caught in pound nets fished in Chesapeake Bay and tributaries, are sold to the menhaden factories located at various points on the bay; the nets are fished primarily for the purpose of supplying the alewife packing houses, but the catch is frequently greater than the capacity of the houses and the fishermen appeal to the menhaden factories to send their steamers to take the surplus fish off their hands. This custom prevails especially about the head of the bay in Maryland waters, where the catch of the pound nets includes not only alewives but many perch which are too small to be marketed.

The argument offered in defense of this is that inasmuch as the fish are trapped and die in the nets it is better to sell them to be converted into fertilizer, and thus serve the farmer and consumers generally, than to pollute the water by throwing them overboard. Despite the claim by the factory owners who send steamers after these fish that they do so at a loss and would rather not be troubled with them, and that they would welcome legislation prohibiting handling them, there seems to be a spirit of jealousy among them, and when the first steamer goes others usually follow. An additional and very strong argument against this practice is the storm of protest and condemnation brought upon the menhaden factories by various persons, who gain an undue impression of the number of edible fish that are made into scrap.

Large quantities of alewife cuttings from the packing houses are utilized at the menhaden factories, but it was impossible to secure definite data regarding the amount, as it is not kept separate from the

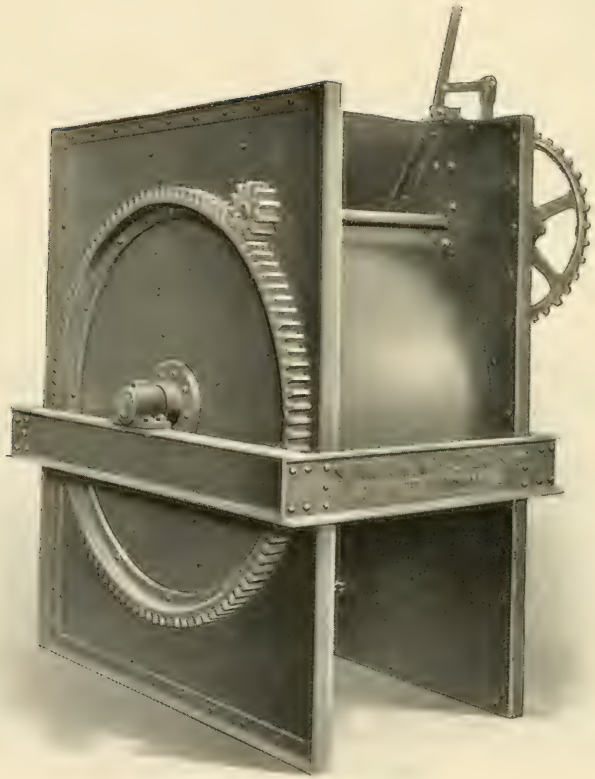
alewives and perch handled; neither is the oil and scrap thus derived kept separate from that made from the menhaden. It has been stated, however, that the major portion of what is shown in the bulletin as "scrap fish and alewife cuttings" was the latter. Some sea robins, swellfish, and skates are taken in pound nets fished near Promised Land, N. Y., and sold to menhaden factories at that place; they are called "evilfish" and are not regarded as being edible, though the fishermen sometimes "saddle" the skates by removing the pectoral fins, which are sent to Fulton Market, New York, where they are sold chiefly to the foreign trade. These fish are not especially desired at the factories, for several reasons; they are not caught in sufficient quantities to render handling them remunerative; they produce very little oil, and they do not pass freely through the modern machinery because of the bone in the sea robins and the cartilaginous character of the skates, which when cooked become so viscous that they stick in the presses.

No special effort is made by the fishermen of the Atlantic coast to catch dogfish, but many are taken on the trawl lines and thrown overboard; it has been suggested that it might be profitable for the menhaden factories to work them up into scrap, but considering the number of fish required for making a ton of scrap and the price received for the latter it is doubtful if the factories could afford to pay the fishermen enough to render it remunerative.

Very little is known by the menhaden factory operators about handling dogfish and other sharks and the machinery as now used is not adapted to this purpose. Some sharks are caught in the purse seines fished in Florida waters, chiefly during the months of May and June. They are not cooked nor cut into small pieces, but the whole shark is thrown on the acidulated scrap heap, where the action of the acid will in time disintegrate it.

UNLOADING AND WEIGHING OR MEASURING.

In former years the fish were all removed from the vessel hold by means of tubs each having a capacity of 500 fish. While this method is now regarded as antiquated, it is yet in use in a few of the smaller factories. The tubs are filled by hand and raised by means of a block and tackle and the fish are dumped into bins or small cars which convey them to the factory. All the larger and best-equipped factories now use a bucket elevator for removing the fish from the vessel. This is very similar to that in use in grain elevators and has proved very satisfactory in fish factories. The elevator is so arranged that it may be lowered into the hold of the vessel, where the fish are fed into it by the "fish gang," consisting of four or more men, and carried up to the weighing or measuring device. One of these elevators can handle 1,000 barrels of fish in an hour with an engine of 20 to 25 horsepower.



FISH MEASURING MACHINE.

The measuring device found in most of the plants is shaped like a cylinder and mounted so as to revolve on an axis. It is divided into four segments, each of which has a space of 22,000 cubic inches, and will accommodate a bulk of fish which is taken arbitrarily as 1,000 in number; this is based on the standard measurement of 22 cubic inches for one, or 22,000 cubic inches for 1,000 menhaden. The number of fish to each 22,000 cubic inches naturally varies with their size. When one segment is filled the cylinder revolves and dumps the fish and the next segment is brought into place to be filled.

Another form consists of two weighing hoppers, with a dial indicator of 1 ton capacity. When one hopper has received the required weight of fish they are diverted into the other by means of an apron-like device which is shifted by a lever worked by the man in charge of the elevator house. Two of the factories have recently installed conveying weighers which are similar in construction to the ordinary platform scales; the track on which the belt which carries the fish moves is suspended from the weighing levers, which with the integrator are inclosed in a sheet-iron case. The fish are dumped from the measuring device into a conveyor, usually of the bucket type, which carries them either directly to the cooker or to the "raw box" or bin in which they are stored until such time as they can be used. These bins are all about the same depth, 10 to 12 feet, but vary in length and breadth according to the capacity of the plant and the number of steamers employed. The largest one in use is about 25 feet wide and 225 feet long. The floor slants toward the middle, where a conveyor moves in a close box with a covering which may be removed in sections when the fish are to be taken from the bin and conveyed to the cooker.

COOKING.

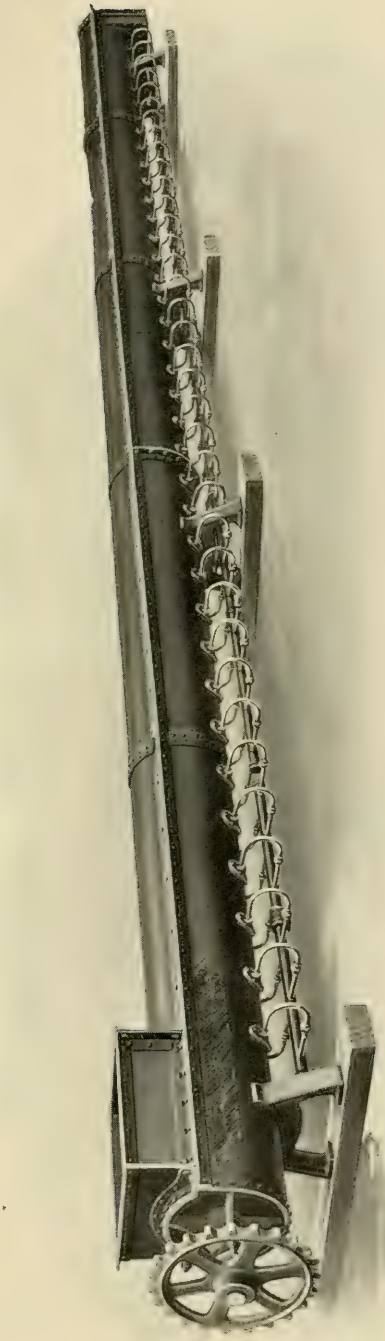
The fish are generally cooked at night as soon as the steamers reach port and discharge their catch. It is desirable to cook them as soon after they are taken from the water as possible, because they putrefy quite rapidly and are so much more difficult to handle in that condition. Cooking has the effect of breaking up the fat cells or sacs and permitting a ready liberation of the oil. The continuous steam cookers have gradually displaced the old-style cooking vats from year to year until the latter have been almost eliminated—North Carolina being the only place where they are now in use—and it is probable that they will be supplanted there by the modern apparatus if the business is sufficiently lucrative to justify the expenditure. The old style consists of the simple process of cooking the fish in vats or tanks having false bottoms beneath which are placed perforated steam pipes; the vats contain a sufficient quantity of water to cover the fish. The water is heated before the fish are put into it, the usual time for cooking the fish in these tanks being about 20 minutes. In

one of the factories of North Carolina the antiquated method of making a fire under the vat still prevails; the vats are made of wood, with iron bottoms.

The modern cookers are of the direct-steam type and operated continuously. The fish are fed through a hopper-like entrance into a steel shell or cylinder of varying lengths and diameters. A cooker finding much favor among the operators of menhaden factories is 40 feet long and 2 feet in diameter; a shaft, the diameter of which varies with that of the cylinder from 3 inches to 4½ inches, passes through the center from end to end and is provided with flights so arranged as to act as a conveyor and keep the fish moving toward the discharge end. Thirty-six iron feed pipes, each three-eighths of an inch in diameter, enter the shell on each side quite near the bottom at intervals of 1 foot; this arrangement insures a complete circulation of the steam through the fish as they are passed through the cylinder. Attached to the discharge end, a little lower than the main cylinder, and either at right angle or parallel to the same, is a smaller shell about 8 feet long and 1 foot in diameter, which is designed to prevent the steam from escaping. The mass of cooked fish drops into this after passing through the cooker and is carried through by a screw conveyor. This is probably the most effective form of this apparatus, as the steam is more thoroughly distributed by being introduced beneath. Other types in use differ chiefly in the manner of admitting the steam. In one form it is admitted through a hollow shaft 6 inches in diameter along which at intervals of 16 inches are arranged sets of radial pipes screwed into the shaft at equal intervals around its entire circumference. These are simply sections of 1-inch iron piping, each 8 inches long. They are closed at the end, but each has three perforations through which the steam escapes to the chamber. These also serve as flights to move the fish toward the discharge end of the cylinder. Another type used in a number of factories feeds the steam through perforations in the shaft, which is fitted with flights which are simply solid pieces of iron.

PRESSING.

While the old-style curbs and hydraulic presses have been displaced to a considerable extent by the modern screw presses, they are yet in use in a sufficient number of factories to justify some description of them; in some of the plants they have been retained after the installation of screw presses, to be used in case the latter should be disabled or in any other emergency that may arise. Many of the operators prefer them to the modern apparatus because the screw press gives such a great pressure that quantities of fleshy matter are forced out with the oil and water, with the result that the separation of these in the oil room is rendered more difficult and the amount of scrap made is



CONTINUOUS STEAM COOKER.

lessened. This is especially true when the fish have become decomposed. It has been claimed that the use of the curbs yields fully 10 tons more of scrap from a million of fish than the screw presses. The mass of fish drops from the cooker to a screw conveyor, which feeds it to a bucket conveyor to be carried to the second floor, where it passes to a second screw conveyor extending through the center of the room over the draining tanks; the box containing this conveyor is provided with troughs through which the mass drops to the tanks, where it remains over night, during which time a considerable quantity of the oil and water drains off and is carried through troughs to the oil tanks.

In the morning the men get into the draining tanks and throw the cooked mass over into the curbs, using a large fork, the tines of which are close enough to retain the solid matter and yet permit a portion of the oil and water to run through. The most common form of curb now in use is a cylindrical tub provided with four wheels, about 20 inches in diameter, so as to run on a tramway which is built alongside the draining tanks; the tub is 40 inches deep, 35 inches diameter at the top, and slightly wider at the bottom; it is constructed of 100 beveled iron staves, three-eighths inch thick, seven-eighths inch wide on the outer side, and slightly wider on the inner side, with sufficient space left between the staves to permit the escape of the oil and water. The staves are securely riveted to heavy iron bands which encircle them, and every tenth stave widens from the center toward the lower end, thus giving the curb an increased width at the bottom so that the hard cake remaining after the pressure is relaxed can be more easily expelled. A hollow core, about 12 inches in diameter and 33 inches long, fits in the center of the curb; this is made of staves similar to those already described and has a rounded top of iron in the center of which is an eyebolt; a hook which may be attached to a chain working in a pulley suspended from above, or to a piece of wood which is laid across the top of the curb, is caught in this eyebolt when the pressed mass is released, to prevent the core dropping. The bottom of the curb is simply a piece of heavy sheet iron attached to the lower band of the curb by means of a loose-pin hinge; the opposite side of the bottom is held in place by a lathe which is opened by a lever when the curb is to be emptied, permitting the bottom to swing. The curb is attached, by means of stays on one of the iron bands referred to above, to a square frame of $\frac{1}{2}$ inch by $2\frac{1}{2}$ inch iron, which is built about it; this frame also serves as the axles, and the spindles on which the wheels revolve are bolted to it at the corners.

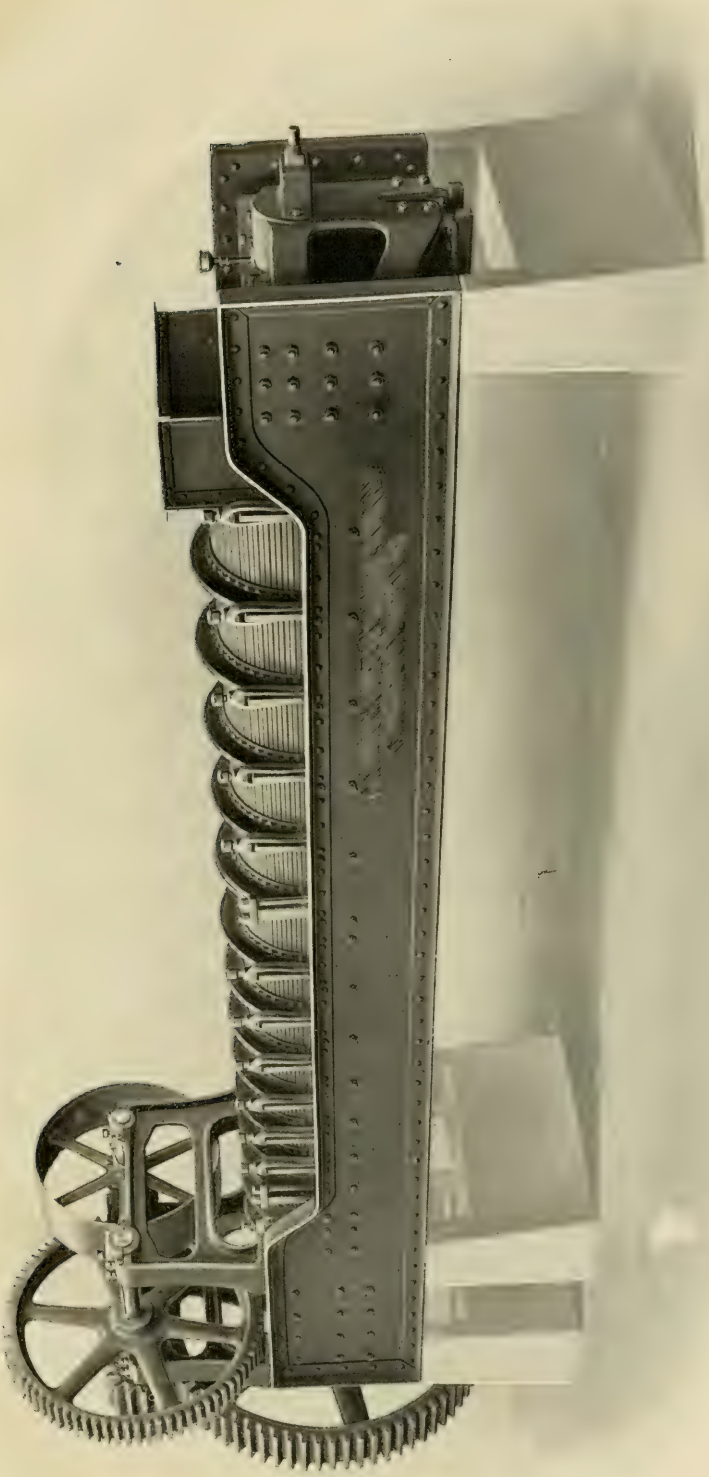
When the curb is filled it is run on the railway to a point under a stationary head which fits closely inside the curb; as the latter is slowly raised by a powerful hydraulic press the fish are pressed

against the head and the remaining oil and water forced out between the staves. The oil and water are prevented from spattering over the workmen when the pressure is applied by shields of metal or other material built around the curb, and as it is forced out it runs through troughs to the oil room. When the pressure is relaxed, the curb slowly descends to its former position on the rails and is pushed from beneath the head and the bottom released by the lever referred to above. The core is held, as has been stated above, and the pressed mass of fish drops through an opening in the floor to the room below. Another form of curb differing slightly in construction from the one just described is in use in some of the plants. The iron bands surrounding it are fitted with latches, which open to release the hard cake remaining after the pressing, and the diameter of the cylinder is the same from top to bottom.

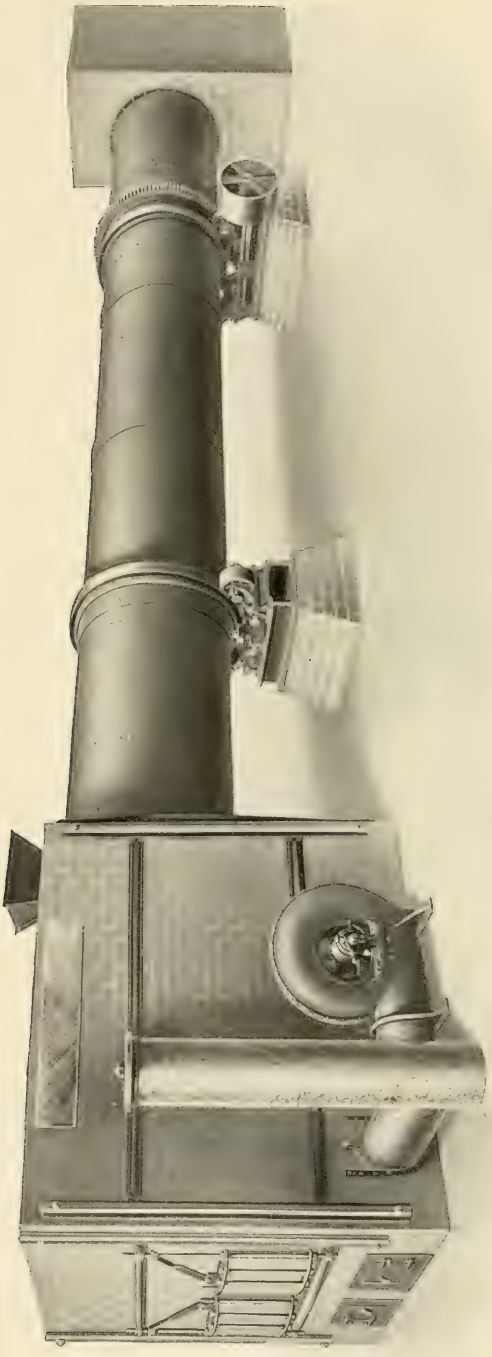
SCREW PRESS.

When the screw press is used the digested fish are conveyed directly from the cooker to the press, thus eliminating the draining tanks referred to as being used in connection with the curbs and effecting a saving in time and labor. The modern screw press consists of a horizontal tapered screw built up on a hollow shaft fitting closely and rotating in a similarly tapered steel-slatted curb with a hopper-shaped entrance 15 by 29 inches in size, into which the fish are fed from the conveyor. A section of the top of the curb may be removed, should the shaft or screw require repairing or cleaning. The pressure is caused by a gradual decrease in the size of the screw and curb, and the material must move toward the small end of the press as the screw turns; it can not turn with the screw nor slip on the curb. The hollow shaft is provided with perforations through which steam may be introduced directly into the material while it is being pressed; this is a decided advantage, in that it keeps the material hot and soft, a condition which permits a more thorough separation of the liquid from the solid matter. The drainage is both internal and external, the drainage space between the slats of the curb being supplemented by the drainage holes in the shaft.

One form of screw press is 18 feet long, or 23 feet including frame and gearing, has a capacity of 80,000 to 100,000 fish per hour, and costs $5,000. Another is 12 feet long, or 17 feet including frame and gearing, with a capacity of about 40,000 fish per hour, and costs $3,500. The larger press requires a 50-horsepower engine, and the smaller one may be operated with an engine of 35 horsepower. Another press very similar to the above is fitted with a cone capable of longitudinal adjustment on the hollow shaft and rotating with the same. The opening through which the pressed fish are discharged



CONTINUOUS SCREW PRESS.



DIRECT HEAT ROTARY DRIER.

is controlled by this cone and the pressure applied to the material while in the press is thus regulated. The oil and water collect beneath the press on the floor, which is made of concrete in many of the factories, and runs through troughs or pipes to the oil tanks for further treatment. According to the information available, there are 4 pounds of oil, 46 pounds of water, and 50 pounds of scrap in 100 pounds of the material as it leaves the press.

DRYING.

Under the old method of drying, the scrap is spread on a platform made of closely fitting boards or concrete, where it is exposed to the sun and air, two or three days usually being sufficient time for this form of drying when the weather is favorable. The scrap is turned over or stirred frequently so that it may all become thoroughly dried; the instrument used for this purpose is usually a wood-tooth harrow drawn by a horse. In the event of rain and at night, as protection from the dew, the scrap is collected into heaps and covered with tarpaulin.

The hot-air drier is now almost universally used in menhaden factories. At some few points, because of the strenuous protest of summer residents against the disagreeable odor emitted by the hot-air drier, the scrap is treated with crude sulphuric acid and sold as "acidulated scrap"; or in some cases it is dried during the winter after the departure of the summer residents. The acid is usually applied as the scrap is being conveyed to the shed in which the acidulated scrap is stored; it may flow in a small stream from a lead-lined tank set near by, or may be poured from a dipper by a man standing near the conveyor box. The estimated quantity used is 1 to 1½ gallons to 500 pounds of scrap. The acid dissolves the bone and also preserves the scrap by preventing the development of flies and other insects.

The pressed fish remains on the floor of the room below the press-room, where it is deposited after leaving the presses, until the following morning, when it is shoveled to a conveyor, usually of the chain type with wood flights placed at intervals of about 2 feet, and carried to the hopper of the drier. The drier is generally set under a shed built apart from the main factory building as a precaution against setting fire to the building should the intense heat in the drier fire the scrap. The direct-heat rotary drier is a revolving cylindrical iron or steel shell of various sizes, through which hot furnace gases pass, generally under forced draft produced by a fan at the side of the furnace. The cylinder has 12 spiral flights or shelves, each 8 inches wide, attached to its inner surface and running the entire length; these add to the rigidity of the cylinder and also lift the scrap to the highest point of the rotation and shower it

through the hot furnace gases. The wet scrap and the gases enter the cylinder at the same end, thus giving the wettest scrap the advantage of coming in contact with the hottest gases and materially economizing both fuel and time. The cylinder is encircled by two steel tires, which are securely fastened to it, each resting on a set of four steel rollers, which in turn rest on brick foundations.

The power for rotating the drier is imparted first to these rollers by means of a shaft and from them by friction to the tires, or by the use of a spur pinion meshing with a large spur-gear ring encircling the drier. The brick furnace, which is provided with an automatic stoker, consumes about 5 tons of coal a day; its size is 9 by 10 feet, and it is built about the front or feed end of the drier, which is set about 9 inches higher at this point than at the other end, so that the trend of the scrap will be toward the lower and discharge end, assisted, of course, by the forced draft which blows it through as the flights referred to above lift it as the cylinder revolves. The lower end enters a brick chimney-like chamber 8 feet wide by 12 feet long; this serves as an outlet for the hot air and the vapor and also as a settling chamber for the dust coming from the dried scrap. A drier, 5½ feet in diameter and 40 feet long, with a capacity of 600,000 fish per hour, costs $2,300; one 50 feet long, with a capacity of 80,000 fish per hour, costs $2,600, exclusive of the brickwork of the furnace and chimney, which costs about $350, and an engine of about 25 horsepower to run it. It is necessary to give close attention during the operation of the hot-air drier in order to guard against burning the scrap by having too much heat and also to keep heat enough to dry it thoroughly. It is sometimes necessary to run it through the second time if the first passage is too rapid. The scrap dried by this process is much darker in color than that dried on platforms, no doubt because it is somewhat scorched by the intense heat of the furnace.

The scrap drops from the drier into a screw conveyor, which passes through the wall of the chimney, and is taken up by a chain conveyor to be carried to the scrap room. The box in which this conveyor moves is usually placed close under the roof of the building and is provided with traps or slides which may be drawn and the scrap deposited in any part of the room desired. Twelve thousand to fifteen thousand fish will make 1 ton of scrap; the quantity made from one million fish varies from 75 to 85 tons.

Fish scrap is used almost entirely for fertilizing purposes; a negligible quantity may be used for chicken feed and as cattle food. The major portion is sold to the fertilizer mixing plants at various places, a large percentage being handled by the Baltimore dealers. Samples are sent to the prospective purchasers, who analyze it and fix the price according to the percentage of ammonia contained in it, which

usually runs 10 to 12 units. Several of the menhaden factories have established their own fertilizer plants and market all of their fish scrap combined with other fertilizer materials under their private brand names. Acidulated scrap is generally shipped in bulk in vessels, but the dried scrap is usually handled in bags, which are furnished by the mixing plants to which it has been sold. The bags are mostly secondhand and of no particular size or quality. Some years ago farmers living in the vicinity of the fish factories frequently used the crude or green scrap for fertilizing their land, but that custom has been practically abandoned during recent years.

During the year 1912 there were manufactured 50,885 tons of dry scrap, valued at $1,532,994; 37,536 tons of acidulated scrap, valued at $603,446; and 99 tons of green scrap, valued at $1,725.

In the endeavor to eliminate the obnoxious odor emanating from the hot-air drier, one of the factory men has evolved the idea of building a frame shed immediately back of and of a similar size to the brick chamber or chimney referred to above and closing the top of the chimney so that the dust and vapor can not escape at that point, but must pass on through a passageway into the shed. In this shed, which may be called a condensing house, is a series of vertical baffles over which are arranged perforated water pipes; the water sprinkled from these pipes condenses, to some degree, the vapor as it enters and circulates through the building and also dampens the dust and prevents it blowing over the neighborhood. The water is carried off through an outlet in the floor.

OIL.

The oily and aqueous liquid flows from the press to the floor, which is made of concrete in most of the recently built plants, and on to a trough leading out to the tanks where the separating is accomplished. It first passes through the receiving tank, where a considerable quantity of the solid matter forced from the press with the liquid is precipitated and drawn off through an opening in the bottom of the tank. The water and oil are separated here to some degree.

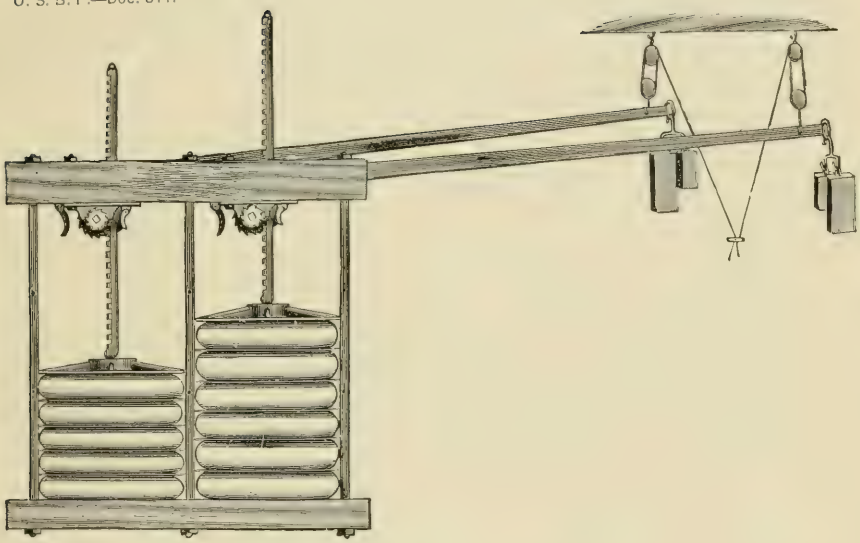
As the liquid flows through the series of tanks the separation is made more complete in each one; it may flow directly over the edge of one tank into the next or into a trough built on the inside of the tank along the side next to the one to receive the oil; the latter arrangement is sometimes called a "self-skimmer." As an aid in forcing the oil to the surface and out, an additional supply of water is sometimes let into the tanks through a hose, the open end of which is placed near the bottom so as to avoid disturbing the surface. Hot water is preferable for this purpose, because when cold it chills the oil. Another method, used chiefly in drawing the oil from the cooking tanks, is the use of a jointed iron pipe, called the

"leader," passing through the bottom of the tank. The open end or top may be raised or lowered to any desired distance beneath the surface and the oil drawn off without disturbing the water beneath. A pump is usually used in connection with this arrangement. The liquid is usually hot when coming from the presses and requires no heating in the receiving tanks. Some of the factories, however, have installed perforated pipes in the bottom of these so that heat may be applied if necessary.

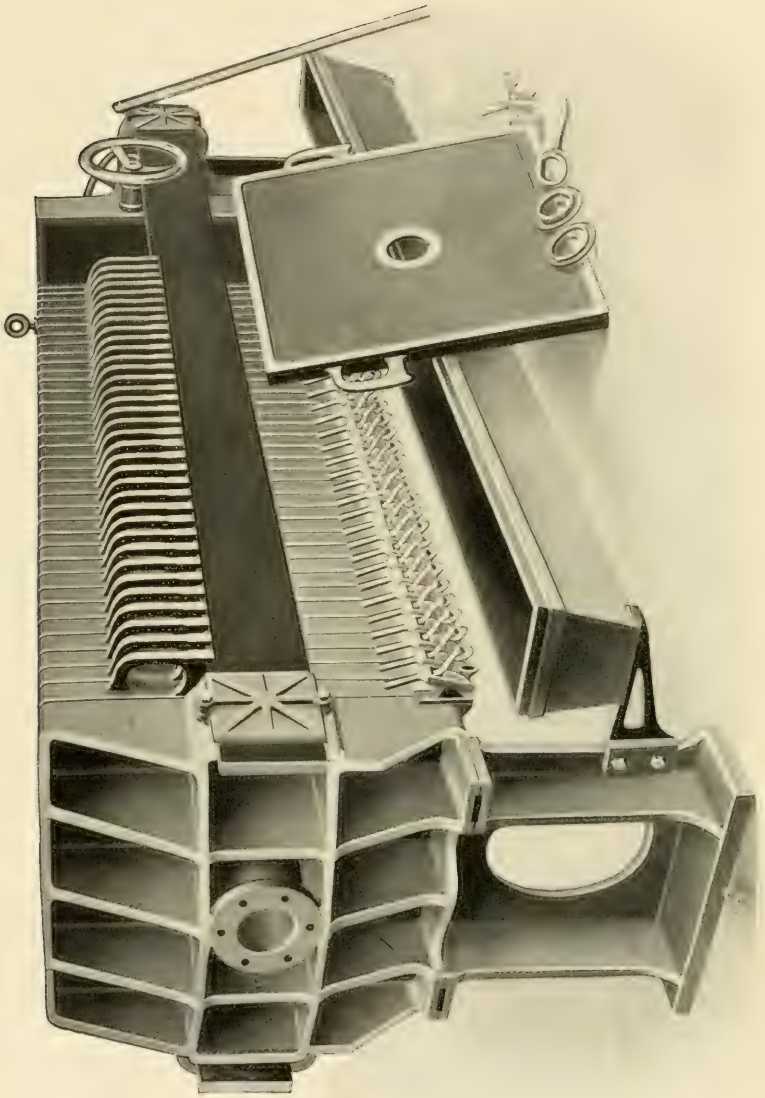
The separating tanks all have a similar arrangement of pipes placed under false bottoms, though only sufficient steam is applied in these to keep the liquid hot, usually about 125° to 150°. The water is drawn from the receiving and separating tanks by means of a "coffee pot" or siphon box 6 by 12 inches in size, built against the inside of the tanks, with the lower end opening about 6 inches from the bottom of the tank. The water, entering here, passes up through the box and out at the top. By the time the oil passes from the last of the series of separating tanks to the cooking tanks it is practically free of water. It is then cooked to the boiling point by steam injected from the perforated pipes placed in the bottom of the tanks, 20 to 30 minutes usually being sufficient time for the cooking process.

After the cooking the oil is sometimes drawn into "cooling tanks," but more frequently it is pumped directly to the storage tanks, which are usually made of metal and are located some distance from the factory. These tanks are without cover, so that the oil may have the benefit of the sun and rain, which improves it by bleaching and washing. Some of the factories have what are known as "catch-all" tanks, into which all the water from the separating and other tanks is run and heated by means of steam introduced by the same arrangement of pipes as has been described above, so that any remaining oil may be extracted. It is said that there is sometimes a considerable quantity of oil saved by this process. The sediment collecting in the bottom of the tanks during the separating and cooking process, consisting of fine particles of flesh, is called "gurry"; this is sprinkled with diluted sulphuric acid, either before or after being conveyed to the gurry-press room, to facilitate the separation of the remaining oil from the flesh particles. It is then cooked 20 to 30 minutes by steam injected by the process above described, and while hot is pressed.

Two forms of presses are used for the gurry. The one most frequently found is very simple in construction; it consists of an iron framework about 10 feet high, forming "bays," each 28 inches wide, in which are a number of steel plates; the gurry is put into canvas bags, about 2 gallons to each; the mouths of the bags are not sewed, but are folded in such a manner as to prevent the semisolid gurry running out. Two bags are placed on each plate, with a total of 100



TWO-BAY OIL PRESS FOR GURRY.



FILTER PRESS FOR GURRY.

to 125 to each bay. The pressure is applied by a lever attached to a pinion working in an upright rack, the lower end of which fits in the head of the press. The bays are usually filled and ready for the pressure by noon, and by evening the process has been completed. The residue, which is a thin, hard cake of scrap, is removed and thrown into the scrap heap, it not being necessary to run it through the drier. The manufacturers of this press can furnish as many bays as are desired by the menhaden factories; a one-bay press costs $70; two bays, $140, and so on; these prices being exclusive of the steel plates, which cost 85 cents each, and the bags.

The economic value of the gurry presses is evident when it is considered that one plant operating a three-bay press gets about 10 gallons of oil and several hundred pounds of scrap a day from the process. The gurry, before pressing, is said to contain equal parts of oil, water, and scrap. The other apparatus which is used in several factories for pressing gurry is a filter press consisting of a series of chambers, 50 in number, formed by recessed plates each 30 inches square. From each side of these plates projecting lugs rest on a pair of parallel bars which are fitted in the frame at each end. The press stands 4 feet high and is 12 feet long. The gurry is pumped in through a channel 3 inches in diameter in the head of the press and distributed over the surface of the filtering medium, which is simply heavy canvas placed between the plates referred to above. The liquid passes through the canvas and runs down and out through cored channels in the lower part of the plates and through outlet cocks to the trough leading to the oil tanks. The advantage of having a separate cock on each plate is that in case one of the cloths should break, that particular plate may be shut off and the filtration need not be interrupted. The solid matter, being retained on the surface of the canvas, gradually fills the chambers until a solid cake is formed in each; the press is then opened, and these are removed and thrown into the scrap heap. The pressure can be regulated by an arrangement which diverts the gurry to the tank from which it has been pumped instead of running it on into the press.

These presses have a capacity of 60 barrels of gurry in 24 hours; one "pressing" can be accomplished in about 3½ hours. The canvas is removed and thoroughly cleaned at least once a day, and an extra set of these is always kept on hand. The gurry in its natural state is so thin that it would run through the press too rapidly, and to guard against this it is necessary to use a filler which gives it a greater consistency. Maple sawdust is generally used for this purpose, the proportion being 2½ to 3 bushels to 10 barrels of gurry.

As the oil flows from the gurry press it is first run into a tank near by, and from there it is pumped to the oil room, where it is rewashed,

and if it is found to be sour it is boiled again. It is then generally run to the storage tanks with the other oil. It is the opinion of some of the oil experts that it should be kept separate, as it is of a darker color and inferior quality, but there is such a small quantity of it, as compared with the other oil, that the operators do not bother to provide separate tanks for it.

The gurry is pressed in most of the factories north of Virginia, but only one plant in that State used such a press prior to 1912. The gurry in the North Carolina factories is not used, but is run overboard with the water from the oil tanks.

The yield of oil varies greatly on different parts of the coast, and also from year to year and at different seasons. The fish are always larger and fatter during the fall than at any other season, consequently there is a greater yield of oil during that period. The fish taken from northern waters produce more than those from southern waters; the writer visited one of the northern factories during August, 1913, and was told that a short time previous to his visit they had made 20 gallons, and that the average yield for July had been 16.5 gallons, per 1,000 fish. The maximum yield for the Middle Atlantic States is about 15 gallons, though it is usually less; in the early part of the season it is very much less than that amount. The south Atlantic fish rarely produce more than 8 gallons per 1,000 fish, and frequently it is less than 1 gallon during the early spring fishing. The average number of gallons of oil made from 1,000 fish during the season of 1912 was as follows: Connecticut, 11.73; New York, 11.36; New Jersey, 5.08; Delaware, 7.72; Virginia, 3.72; and North Carolina, 1.98.

The manner in which the oil is handled in the process of separating and cooking has a great deal to do with the amount produced. While the principle is practically the same at all the factories, some oil tenders can extract a greater quantity than others, and also make a superior grade.

Practically all of the crude menhaden oil is sold to dealers in New York, New Bedford, Baltimore, and Boston, where it is refined, bleached, and winter-pressed. The grades, as produced by the refineries, are "Extra bleached winter fish oil," "Bleached winter fish oil," "Light winter-pressed fish oil," and "Brown winter-pressed fish oil." Some is exported in the crude state, but only when the prices in this country are especially attractive or when the foreign oils are not available. It is graded from samples sent by the manufacturers to the oil dealers, according to the color and condition. The standard grades are A, B, C, and D, varying from a clear amber color to a dark brown, or in some cases nearly black, depending chiefly on the condition of the fish when reaching the factory. When fresh they usually produce a clear, sweet oil; if they are putrified the

oil is dark, and if the decomposition has reached a well-developed state, it is likely to be "off in smell," having a disagreeable odor as of decayed fish.

The quality of oil made from fat fish is superior to that from thin ones. There is a noticeable difference in what is made from fish caught in Chesapeake Bay and that made from fish caught by the same fishermen at sea, the latter being of a superior quality. Grade A from sea fish is one to three shades lighter than the same grade from the bay fish. Menhaden oil is used chiefly in the manufacture of paints and varnishes. Some is also used in tempering steel and tanning leather, though a very small quantity is used for the latter purpose as compared with what was used in former years, because the curriers are now using mineral oils and compounds which are less expensive than fish oil.

An apparatus for evaporating the water which is separated from the oil and known as "stick water" has recently been installed in one of the factories. It is an oval-shaped iron shell standing 8 feet high, 4½ feet wide, and 18 feet over all. The working part consists of a cylinder of 96 tubes, held in place by bearings at each end of the casing and made to revolve by means of gearing on the outer ends of the hollow shaft. Steam is introduced at the end of the rotating tube shaft and the condensed water is drawn off at the opposite end. The construction of the drainage from the steam tubes is such as to prevent the water collecting in any part of the steam drum or tubes. The material to be evaporated is let in through an opening at the bottom of the machine, at the same end the steam enters, and the finished product is drawn off through an opening in the opposite end. The vapor arising from the material is drawn off by a vacuum pump attached by pipe to an opening at the top of the machine. One 20-horsepower pump is sufficient for two evaporating machines. Exhaust steam can be used to do the evaporating with this machine to a decided advantage, as it will do the work as well as low-pressure live steam. The residue or "stick" will average about 9 per cent ammonia; it is a brownish, sticky substance and can be used as a fertilizer when mixed with other fertilizer materials. The writer saw some at the plant referred to that had been mixed with fish scrap—1 pail of stick to 4 pails of acidulated scrap and another mixture of 1 pail of stick to 3 pails of scrap. It seemed to be well mixed and was not "gummy," though it would probably have to be dried before it could be placed on the market. The analysis of "stick" is: Moisture, 15.99; grease, 0.16; ammonia, 9.24. This machine has been used at reduction plants with success, and it would seem that some of the larger menhaden plants might use it to advantage. The cost of a machine is approximately $4,000.

FISHERMEN.

The crews of the northern steamers are made up chiefly of Newfoundlanders and Nova Scotians. Those on the southern vessels are mostly natives, and, with the exception of the captains, mates, engineers, firemen, and some of the strikers, are colored. Many of the steamers also carry white pilots, because the captains are too busy directing the fishing operations to tend the wheel. The men, especially in the south, usually live adjacent to the factory for which they are fishing and go home as frequently as their work will permit. The captain, who must be a practical fisherman, in addition to having a knowledge of the coast, receives no stipulated salary but is paid a bonus of 12½ to 18½ cents for each 1,000 fish caught. The monthly pay received by the other members of the crew is as follows: Mate, $100, or $50 and a bonus of 4 cents per 1,000 fish, or $25 and a bonus of 5 cents per 1,000 fish; pilot, $85 to $90; engineer, $90 to $125; assistant engineer, $60 to $80; firemen, $35 to $45; striker, $60, or $35 to $40 and a bonus of 1 or 1½ cents per 1,000 fish; cook, $60 to $75; and $35 to $45 for the fishermen. In addition to this the employers furnish subsistence for the entire crew. The custom in the fisheries of North Carolina differs somewhat from the above wage scale, in that the entire crew works on shares and they also find their own food; seventy-five to eighty-five cents is allowed the crew for each 1,000 fish taken. Of this, the captain gets 15 cents, and the others 5 cents each, but the captain usually gives the mate an additional 2½ cents, the cook 1 cent, and the engineer 1 to 2 cents per 1,000.

FACTORY EMPLOYEES.

The men employed in the fish factories of the Chesapeake Bay region are secured chiefly from brokers in Baltimore; they are of various nationalities, including German, Irish, Polish, and Norwegian; the writer saw a man at one of the Reedville plants said to be an Indian and a very good workman. Those on the Delaware and New Jersey plants are practically the same class as in Virginia and are brought from Baltimore and Philadelphia. Many of the men at the New York factories are Portuguese.

In addition to subsistence furnished them, the monthly pay of the men at the various factories is as follows: Foremen, $50 to $125; assistant foremen, $40 to $80; engineer, $35 to $100; assistant engineer, $25 to $60; firemen, $30 to $40; oil tenders, $30 to $100; machinist, $50 to $100; seine menders, $35 to $100; cook, $60 to $90. There are also a number of others doing general work about the factory at wages ranging from $15 to $40. It is quite difficult to hold the latter class of men any length of time, and as an inducement some of the operators offer a bonus of $5 per month if they remain throughout the season. This custom, however, prevails in only a few plants in Virginia.

LAWS GOVERNING MENHADEN FISHING.

The legislatures of most of the States in which the menhaden industry is prosecuted have adopted laws governing the work. In New York a license of $50 is required for each steamer of 50 tons or more, and $25 for every other vessel engaged in fishing with nets in the tidal waters of the State for the purpose of making oil or fertilizer from the fish product taken; and a fine of not less than $100 is provided for taking food fish for the purpose of converting them into oil and fertilizer. The New Jersey law imposes a license of $100 for each steam vessel of not more than 50 tons net, $125 for each steam vessel of over 50 tons and not more than 100 tons net, and $200 for each steam vessel of over 100 tons net taking menhaden with purse seines. The law in Delaware requires the payment of a license of $100 for each steamer not over 125 net tons, and $200 for each steamer over 125 net tons employed in the taking of menhaden by means of purse seines.

The menhaden fishermen of Maryland are required to pay a license of $25 for each net used and are not allowed to fish with such nets at any point north of a line drawn east from Sandy Point to Love Point. The penalty for violation of this law is a fine of $50 and confiscation of the boat and all the fishing gear. The Virginia law is the most severe of all the menhaden fishing laws; it states that "it shall be unlawful to take, catch, or round up with a purse net for the purpose of manufacturing into guano, food fish to the amount greater than one per centum of the whole catch without immediately opening the net and turning loose any such food fish while yet alive; or for any steamer or vessel licensed for the purpose of menhaden fishing to catch any food fish for the purpose of marketing same; or for any person, firm, or corporation to have in possession food fish to a greater amount than one per centum of the bulk for the purpose of manufacturing them into guano or oil, except that herring caught in pound nets may be marketed and used for the purpose of such manufacture. Any person, firm, or corporation violating any portion of this section, or having in their possession as much as one per centum of food fish among menhaden caught for the purpose of manufacturing into guano or oil, shall be fined not less than one thousand nor more than three thousand dollars, and the license on such person's boat or net shall be revoked for the remainder of the season." It is believed that the menhaden fishermen of Virginia are in sympathy with this statute and endeavor to abide by it. The license for a steamer fishing in the State waters is $100, and nonresidents are excluded. The North Carolina statutes provide no license for fishing with purse seines for menhaden.

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